VARIABLES IN RESEARCH

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ABSTRACT:

In research, variables are fundamental elements that represent measurable traits or characteristics subject to change or variation. They play a critical role in defining and guiding the study's design, data collection, and analysis. Variables are typically categorized into three main types: independent variables, dependent variables, and controlled variables.

The independent variable is the one manipulated or changed by the researcher to observe its effect on the dependent variable, which is the outcome of interest being measured. For instance, in a study examining the impact of different teaching methods (independent variable) on student performance (dependent variable), the teaching method is altered to see how it influences performance.

Controlled variables, or constants, are the elements kept the same throughout the experiment to ensure that the results are attributable only to the manipulation of the independent variable. Additionally, extraneous variables, which are not of primary interest but could influence the dependent variable, should be minimized or accounted for to avoid skewed results.

Operational definitions are crucial in research, as they specify how variables are measured or manipulated within the study. This clarity ensures that the research is replicable and that the findings are valid and reliable.

In sum, understanding and appropriately managing variables is essential for the integrity and success of any research project, as they directly impact the study's conclusions and the ability to generalize findings.

Keywords: Variables, independent variable, dependent variable, controlled variables, extraneous variables, Confounding variables, Categorical variables, operational definitions, research design, data analysis.s

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INTRODUCTION:

In research, the focus is usually on trying to understand the relationship between two activities or to analyze the effect of one activity on another. These activities are the variables and it is pertinent to define and identify the variables while designing quantitative research project. A variable incites excitement in any research than constants. It is therefore critical for beginners in research to have clarity about this term and the related concepts. Suppose, an experiment is conducted to know about the time taken by different employees who have slept 2,4,6 and 8 hours, respectively to complete a task. Here, the variables will be the number of sleeping hours and the time taken to complete the task**.** ***An entity which can be measured is a variable or in other word we can say that a variable is a property that takes on different values***. Here the sleeping hours as well as time taken can be measured qualitatively, so the variables in this case will be '***time taken to complete the task***' and ***'sleep hours'***. Qualitative concept can also be quantified on the basis of absence or presence, scales from 1 to 5, etc.

Variable, to put in layman statement is something that can change and or can have more than one value." A variable as the name implies, is something that varies". It may be weight, height, anxiety level, income, body temperature, subject marks and so on. Each of these properties varies from one person to another and also has different values along a continuum. It could be demographic, physical or social and includer religion, income, occupation, temperature, humidity, language, food, fashion, etc. Some variables can be quite concrete and clear, such as gender, birth order, types of blood group etc., while other can be considerably more abstract and vaguer.

Variable is a property that takes on different values. It is also a logical grouping of attributers. Attributes are characteristic or qualities that describe an object. For example, if gender is a variable, then male and female are the attributes. If residence is the variable, then urban, semi urban, rural become the attributes. So, the attributes here describe the residence of an individual.

DEFINITION OF VARIABLE:

- In Research, Variables refer to characteristics or attributes that can be measured, manipulated, or controlled. They are the factors that researchers observe or manipulate to understand the relationship between them and the outcomes of interest.
  - **OR**
- In research, a variable is any characteristic, attribute, or factor that can be measured or observed and that can vary across individuals, groups, situations, or over time. Variables are central to the design and analysis of research because they are the entities that researcher's study to understand relationships, causes, and effects.

MEANING OF VARIABLE:

Referring the above definitions of variable, we can say that any such characteristic or attributes, possessed by any living or non-living unit or thing, is called variable whose values may change per unit or per groups of units. Such characteristic is called variable characteristic in research study.

Some examples of variable are given below.

If we want to study the number of members in families of a village, the number of members will be variable characteristic, because value of this number will change per family and family will be considered as a unit of study.

In the same way, if we want to study Mathematical Reasoning Ability (MRA) of students, MRA will be considered as a variable characteristic and students will be considered as units of study.

MEANING OF SUBJECT OF STUDY:

The unit that possesses variable characteristic to be studied is called subject of study. Employee, in our above mentioned, will be considered as subject of study.

In the same way, if we want to study Teaching Aptitude (TA) of high school teachers, the high school teacher will be subject of our study and TA will be considered as variable characteristic under study.

Generally, in research studies, if the variables are taken care of, interrelationship among the variables or impact of one or more variables on other variables is studied. Sometimes, interactive effect of some variable/s is studied through research. If variable based study ids to be done through research activity, researcher must have the understanding of types of variables.

TYPESOF VARIABLES IN RESEARCH:

CONTINUOUS VARIABLE	NON-CONTINUOUS VARIABLE OR DISCRETE VARIABLE
• These can be expressed continuously i.e .in decimal as well . • Example- Height, Weight, percentage of marks, etc.	• These can only be expressed as whole numbers. • Example- Number of students in a class, family members, etc.

DEPENDENT VARIABLE(DV)	INDEPEDENT VARIABLE(IV)
• It is a variable which is under the influences of another variable or which is affected by another variable of the system. • It is a variable which does not influences or affect another of the system.	• This is not under the influences of any other variable in the system. • It is a variable which influences or affects another variable of the system.
• For example, in the above study of sleeping hours and time taken, the variable sleeping hour is an independent variable, as it is not getting affected by the time taken to complete the task, rather we are to study its effect on the time taken. So, the time taken to complete the work is the independent variable.	
EXTRANEOUS VARIABLE	
• These are the variables which have an effect on the dependent variable, but are not part of the system. In the above discussion of sleeping hours and time taken to complete the task, there can be many other variables which affect the time taken to complete the task such as mood of the employee, his willingness to complete it, any other work he has, his	

health, etc. Because in this study we are to check the effect of sleeping hours on working efficiency, other variables have been excluded from the system; so, all these are extraneous variables. Their effect is not considered in the study, but they do affect the time taken to complete the task; so, their effect will be termed as "experimental error". All these omitted variables are included in 'Error term' in Economics.

CONFOUNDIND VARIABLES

- These are also similar to extraneous variables as they are also not part of the system. But these differ in the extent of their influences. These have stronger influences than the extraneous variables.

CATEGORICAL VARIABLES

- These variables have only a specified set of options.
- For Example, the variable 'blood group' can have four options-A, B, AB, O , or eight options A+ , A- , B+ , B- , O+ , O- ,AB+ , AB-

ACTIVE VARIABLE	ATTRIBUTE VARIABLE
• These can be changed and are under the control of researcher. • Example: monthly expenditure of a house hold on vegetables.	• These cannot be changed and are not under the control of researcher. • Example: age, gender of respondents.

CONTROLLED VARIABLE

- A control variable (also called a controlled variable) is a variable that is kept constant or unchanged throughout a research experiment to prevent it from influencing the relationship between the independent variable and the dependent variable. Control variables help researchers isolate the effect of the independent variable by ensuring that other potential influencing

factors do not interfere with the results.

- Example: Keeping the room temperature constant during an experiment on cognitive performance.

ACTIVE VARIABLES	ATTRIBUTED VARIABLES
• These can be changed and are under the control of researcher. • Example: Monthly expenditure of the household on vegetables.	• These cannot be changed and are not under the control of the researcher. • Example: age, gender of respondents.
• Active and attributed variables are types of independent variables.	

DEMOGRAPHIC VARIABLES
• "Demographic variables are the characteristics or attributes of subjects that are collected to describe the sample". They are also called sample characteristics. It means these variables describe the study sample and determine if the samples are representative of the population of interest. Although demographic variables cannot be manipulated, researchers can explain relationship between demographic variables and dependent variables. Some common demographic variables are age, gender, occupation, marital status, income tax etc.

VARIABLES	EXAMPLES
• Dichotomous Variables	• Gender: Male and female • Types of property: Commercial and residential • Pregnant and non-pregnant • Alive and dead • HIV positive and HIV negative • Education: Literate and illiterate
• Trichotomous Variables	• Residence: Urban, semi urban and rural • Religion: Hindu, Muslim, Christianity and Buddhism,

	etc.
• Multiple Variables	• Blood Groups: A, B, AB and O

MEASURING VARIABLES:

In order to do an analysis, the variables have to be quantified; this means measuring giving values and the scales. Sometimes identification of variables and determining how to measure them looks quite simple but due to vaguely defined variables measuring can be difficult too. There are four levels of measurements on a continuum of discrete and continuous: Nominal scale, Ordinal Scale interval scale and ratio scale. Now we discuss these four scales in detail below:

- **Nominal Scale:** It is used for variables which can be categorized, but cannot be ranked. For example, blood group of the respondent can have response A, B, AB or O. Here, responses can be categorized, but cannot be ranked.
- **Ordinal Scale:** It is used for the variables which can be categorized as well as ranked, that is, where one choice is superior to another; so, these can be ranked on the basis of their levels. It is usually used to measure nonnumeric or qualitative concepts like happiness, sadness, satisfaction, level of pain, and so on. For example, when asked about the satisfaction of the service respondents can reply by choosing one of these very satisfied, satisfied, neutral, dissatisfied and very dissatisfied. Similarly, any statement can have options strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. Marks scored by students in a test can be categorized qualitatively as above average, average below and average.
- **Interval Scale**: It is used for the variables involving the quantity which can be categorized rank as well as can be expressed in increments with known measurable consistent and equal intervals. These types of variables include time, temperature, percentage of marks scored by the students, etc. Time like sleeping hours can be expressed in equal interval of 1 hour as 1 ,2 ,3 ,4 ,5, 6 ,7, 8 hours.
- **Ratio Scale:** It is used when a variable which can be categorized, rank, and expressed in equal intervals, can have an absolute zero value, that is,

the starting point of the scale is taken as zero. Ratios can be calculated using these measurement variables say monthly views on YouTube channel can be expressed as "this month we had thrice the number of views than the last month".

E.g. gender, marital status, race, diagnosis, blood group etc. Ordinal scale is one where the variables are categorized that can be ranked. E.g. Levels of pain mid, moderate or severe. Interval scale measures equal numerical distances between the intervals. It can be categorized, as well as ranked. difference between 70 degree and 80 degrees will be the same as the difference between the 30 degree and 40 degrees. So, the interval is of 10 degrees in both the categories. Ratio scale measures the variables which can be categorized, ranked, have equal intervals and can represent continuum of the values.

SCALES FOR MEASURING VARIABLES				
Variable can be:	Nominal Scale	Ordinal Scale	Interval Scale	Ratio Scale
Categorized	Yes	Yes	Yes	Yes
Ranked		Yes	Yes	Yes
Equal Intervals			Yes	Yes
Continuity of values				Yes
Used in measuring	Marital status	Level of difficulty of exam	Percentage of students (at interval of say 5%)	Working hours

DEFINITION OF HYPOTHESIS:

- It (Hypothesis) is a suggested answer to the problem under investigation –John T. Townsend
- A hypothesis is a tentative generalization, the validity of which remains to be tested ------- J.W. Best

- A hypothesis is a proposition which can be put to test to determine its validity. It may be proved correct or incorrect. ---- Good &Hatt
- A hypothesis is a conjectural statement of the relation between two or more variables. ------ F.N. Kerlinger

FUNCTIONS OF HYPOTHESIS:

The main functions of the hypothesis are given below:

- It brings clarity, precision, and focus in research process.
- It facilitates the formulation of theory.
- It provides a direction to the research defining the variables.
- It enhances the objectivity.
- It prevents blind research.
- IT provides a temporary theory or generalization which after verification becomes a well-accepted theory.

TYPES OF HYPOTHESIS:

Null Hypothesis: It is the best of study. this signifies that is no difference between two phenomenon or situation. It is denoted by H0 or HN. For example,

- H0: There is no difference between the effect of a drug A and B.
- H0: Skin problem is not caused by the Chemicals in makeup products.
- H0: Girls and boys are from equally well in the mathematics test.

Alternative Hypothesis: Alternative hypothesis is considered to be true if the null hypothesis is rejected. It is the opposite of null hypothesis. It is denoted by H1 or HA. For example,

- H1: There is a difference of effectiveness of drug A and B or
- H1: Drug A is more effective than drug B
- H1: Skin problems are caused by the chemicals is make up products.
- H1: Girls and boys do not perform equally well in mathematics test.

Hypothesis test can be positive or negative statement.

Suppose the hypothesis is ‘women perform better in administrative jobs than men’. It will not be a null hypothesis, as null hypothesis is of hypothesis of no difference. This will be an alternate hypothesis. Null hypothesis, in this case, will be ‘women and men perform equally well in administrative jobs’, this mean that there is no difference in their performance.

- H0: Women and men perform equally well in administrative jobs.
- H1: Women perform better in administrative jobs than men

CHARACTERISTICS OF HYPOTHESIS:

- It should act as stimulus to research.
- It should be expressed simply, specifically, and should be conceptually clear.
- It should be a verbal statement of the relationship between two or more variables.
- It should be future oriented, that is, should have the ability to predict future events.
- It should have the ability to enhance objectivity.
- It should be verifiable. If it cannot be verified, then conclusions cannot be drawn from it without checking its validity.

OPERATIONAL DEFINITIONS:

Operational Definitions refer to the specific criteria, procedures, or measurements used to define and quantify variables in a research study or experiment. Here's a concise breakdown:

- Purpose: To ensure clarity and consistency in how variables are measured or observed. It standardizes terms and concepts to avoid ambiguity.
- Types: Measurable Variables: Numerical values, e.g., "height is measured in centimetres.
- "Observable Behaviours: Specific actions or reactions, e.g., "aggression defined as the number of times a person shouts during a 10-minute interaction."
- Characteristics:
- Specific: Clearly details how a concept is measured or observed.
- Replicable: Enables other researchers to replicate the study with the same criteria.
- Objective: Minimizes subjectivity by using clear criteria.
- Example:
- Abstract variable: Intelligence.
- Operational definition: "Intelligence is defined as the score obtained on a standardized IQ test.

DATA ANALYSIS:

It involves the systematic application of statistical or logical techniques to describe, summarize, and evaluate data. Here are key points:

Purpose: To identify patterns, relationships, and trends within data.
To draw meaningful conclusions and support decision-making based on evidence.

Types:

Quantitative Analysis: Uses numerical data and statistical methods (e.g., averages, correlations).

Qualitative Analysis: Analysess non-numerical data like interviews or observations to identify themes or insights.

Mixed Methods: Combines both quantitative and qualitative approaches.

Steps: **Data Cleaning**: Removing errors or inconsistencies.

Descriptive Statistics: Summarizing data (e.g., mean, median, mode).

Inferential Statistics: Making predictions or inferences about a population based on sample data (e.g., t-tests, regression).

Interpretation: Analysing results to draw conclusions related to research questions or hypotheses.

Tools: Software like SPSS, R, Excel, or NVivo for data processing and analysis.

Importance: Provides empirical evidence to support research findings. Facilitates understanding of complex data through visualization and statistical summaries.

In research, data analysis is crucial for transforming raw data into actionable insights and validating hypotheses. Operational definitions are critical for empirical research as they bridge the gap between abstract concepts and practical measurement.

The next step is to prepare the research design and it is the most difficult part of planning a research study is identifying the research variables and research design. Considerable time and thought needs to give this step. Once the variables have been identified, then the research study can be developed until the research problem, its objectives, variables have been decided and the hypothesis is formulated after a detailed review of literature and then the research study can be developed.

Summary: In the above topic "**Variables in Research**", I have discussed in due course about the variables, their nature, classifications and uses in the research field. This is an important step in the research methodology. Also here here discuss about the different types of data, measure of data and a rigorous concept of data analysis, testing of hypothesis. Henceforth I reached in conclusion that every research scholar has a fruitful idea about the variables, data and data analysis for their research works onwards.

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